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1971

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#### Recommended Citation

Derscheid, L. A.; Krueger, C. R.; and Rumbaugh, M. D., "Alfalfa Management" (1971). *SDSU Extension Fact Sheets*. 1209.

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# Alfalfa Management



COOPERATIVE EXTENSION SERVICE  
SOUTH DAKOTA STATE UNIVERSITY  
U. S. DEPARTMENT OF AGRICULTURE



# Alfalfa Management

By  
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Alfalfa is the most productive, long-lived and nutritionally valuable legume in South Dakota. It is useful for soil-building, hay, silage and pasture. Presently, it is being used on too few acres as a soil-builder and much of its forage value is not used to its full potential. Although about 2.2 million acres of alfalfa are harvested annually for hay, farmers are not making full use of it as a pasture crop and they are not obtaining maximum yields of hay or silage. With more concern for factors such as variety, growth characteristics, soil fertility, and management, farmers could easily get more of their "money's worth" from alfalfa.

South Dakota's average yield of alfalfa hay is only about 1.5 tons an acre. Research indicates that yield can be increased 7% throughout the state by using better varieties and at least 25% by using recommended management practices. Average yield of recommended varieties at seven research stations is 2.7 tons an acre.

## ALFALFA POTENTIALS

Using research data from various areas of the state, forage crop and soil fertility specialists estimate that alfalfa production can be increased by over 1 million tons and income can be increased almost \$14 million by increasing yield through improved management. These estimates are shown in Table 1 for various areas of the state.

Average per acre yields of recommended varieties at Agricultural Experiment Station sites are:

2.5 tons at Watertown;	1.2 at Cottonwood;
3.5 at Brookings;	1.1 at Eureka;
3.3 at Menno;	5.4 at Redfield on
2.0 at Highmore;	irrigation

Alfalfa-grass pastures produce more beef per acre than straight grass. The difference was about 72 pounds annually over a 5-year test at Brookings and 59 pounds annually during 3 years at Newell.

Alfalfa is well-adapted for use under irrigation. Long time irrigators in Butte and Lawrence counties average 2.6 and 3.1 tons an acre, respectively, while dryland producers average 0.85 to 1 ton an acre. Experience with irrigation has resulted in increasing yields from 2.8 tons an acre in 1964 to 5.1 tons in 1969 in Spink County.

This publication discusses management practices needed to increase alfalfa production to the levels that specialists believe possible. Since many management practices are based on growth characteristics of the alfalfa plant, a discussion of these characteristics is included.

## ALFALFA-GRASS MIXTURES

Grasses generally are recommended in mixtures with alfalfa grown for pasture. The reasons are that pasture mixtures including at least 50% grass with a legume may reduce bloat, grasses reduce soil erosion and improve soil structure, and grass gives more assurance of a stand. Mixtures are a safeguard against a loss in alfalfa stand due to thinning from winterkilling. Smooth brome grass and intermediate wheatgrass seldom winterkill. Grasses also increase the possibility of a full stand throughout a field, decrease the chances of alfalfa heaving during early spring, and hold back ingress of weeds and undesirable grasses in thin spots of the alfalfa stand. Mixtures with grass also cure more rapidly and make better silage than alfalfa alone.

Disadvantages of mixtures are that most grasses with jointed stems produce the bulk of their annual yield in the first cutting and can be weakened severely by cutting at a stage when their stems are beginning to elongate.

## STAND ESTABLISHMENT

The three essentials to good stand establishment are:

- (1) seed at a uniformly shallow depth;
- (2) seed in a firm seedbed; and
- (3) remove competition from new seedlings for 30 to 60 days after emergence.

More detailed information about stand establishment, seeding equipment, alfalfa-grass mixtures, rates of seeding and the use of companion crops is given in Fact Sheet, "Planting Tame Pastures and Hayland."

Table 1. Estimated increase in yield, total production and increased income that can be realized from better management of alfalfa.

Area	No. of Counties	Yield		Increased Production (tons)	Increased Income (dollars)
		Present (tons)	Potential (tons)		
Northeast .....	10	1.65	2.5	284,000	3,880,000
North Central .....	16				
East half .....		1.41	2.0	238,275	3,267,500
West half .....		1.24	1.4	36,175	135,500
Southeast .....	13				
Extreme S. E. ....	5	2.40	3.4	148,900	2,282,000
Adjacent .....	8	1.90	2.5	88,650	1,188,600
South Central .....	11	1.15	1.4	107,100	1,392,300
Western .....	14	1.00	1.2	84,000	1,092,000*
Black Hills .....	3	1.49	2.0	51,250	666,250*
TOTAL .....	67			1,038,350	13,903,850*

\*Estimated at \$13.00 (average for other areas) per ton of increased production.



## HARVESTING

Harvesting management is a compromise between securing a high yield of quality forage and maintaining an adequate level of carbohydrate reserves in the roots.

### Cutting Recommendations

The present recommendation is to cut alfalfa whenever it reaches the stage that first flowers begin to appear. Plant development thus determines the number of harvests that can be taken during a season of normal growth. Over years and varieties, three to four cuttings at first flower may be possible at southeastern locations in South Dakota while only one to three cuttings will be possible at northern and western locations. Available soil moisture, temperatures, and length of growing season vary from year to year causing fluctuations in growth rate and time alfalfa plants start to flower. Development of new shoots from the crown as the top-growth reaches maturity is another indication that the crop is ready to be cut even though no flowers are present.

Killing frosts in late May should be followed by immediate harvest of the forage. Cutting prior to the appearance of flowers is also desirable to control heavy infestations of pea aphids, leafhoppers, and other injurious insects, if present. Drought may halt growth of the second or third crop. Color of the foliage in fields of alfalfa under moisture stress assumes a gray (sometimes blue-green) cast and the crop should be harvested if the amount of standing forage economically justifies the cost of the operation. If the field is not cut, drying and leaf drop will soon lower the quality and quantity of the crop while the plants continue to extract soil moisture which would otherwise be saved for regrowth.

Growth occasionally may be sufficient to harvest a hay crop on September 1, even though the plants may not yet be in first flower. Cutting at this time would be recommended in order to obtain additional forage and to remove the crop ahead of the critical autumn period. Cutting after September 1 should not be practiced because it does not give the plants sufficient time to prepare for winter dormancy. Because of South Dakota's severe winter temperatures, alfalfa needs the entire autumn period to properly prepare for winter and a stubble to catch snow for winter insulation.

It is often impossible with large acreages to cut all forage in the spring at the first flower stage and to make 3 cuttings before September 1. In such a case, it is necessary to start earlier than first flower in some fields so that the last fields are not cut too late for high quality. The following year it would then be best to cut those fields early that were cut less frequently the previous year.

In summary, alfalfa should be harvested whenever:

- (1) the first flowers appear;
- (2) new shoots  $\frac{3}{4}$  inch tall develop from the crowns of over 60% of the plants;
- (3) growth is severely retarded by frost, drought, insects, or disease;
- (4) but never between September 1 and the first killing fall frost.

The harvesting system is closely related to food production, root reserves, and cold resistance. The Wis-

consin Agricultural Experiment Station has reported on principles that regulate harvesting. Much of the material also applies to South Dakota and some Wisconsin data are used in this section.

### Food Production

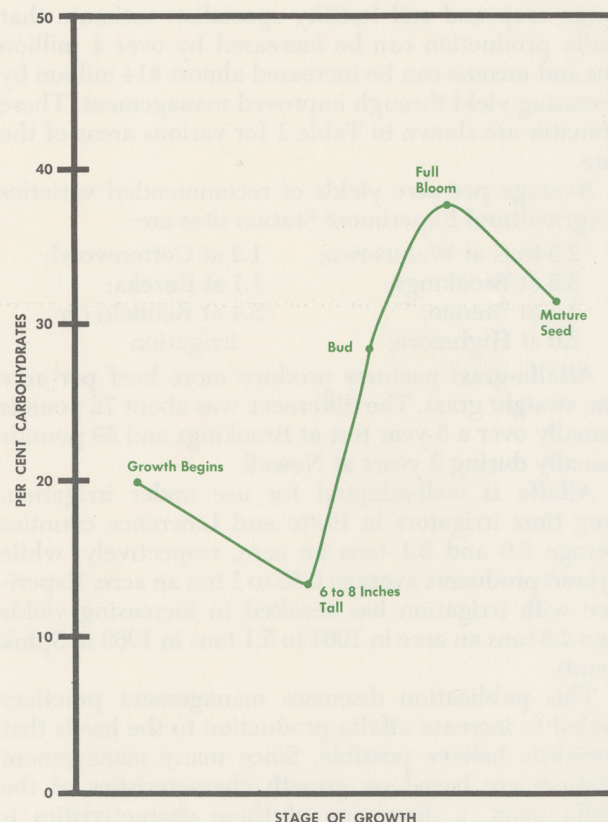
Alfalfa plants live and grow on food manufactured mainly in their leaves. Carbon dioxide from the air enters the leaves through small pores (stomates). At the same time, water moves from the soil into the roots and upwards inside the plant. Green chlorophyll in leaves and stems absorbs sunlight which furnishes energy to manufacture carbohydrates (starches, sugars) from carbon dioxide and water. Other nutrients, such as nitrogen, phosphorus, and potassium, are obtained primarily from the soil. Plants combine these elements with the "manufactured" carbohydrates to produce proteins, fats and oils.

### Food Reserves in Roots and Crowns

Alfalfa is a perennial that stores energy in the form of readily available carbohydrates in roots and crowns. They are called root reserves.

Figure 1 illustrates that there is a certain amount of carbohydrates in alfalfa roots when growth is initiated in the spring. Some of these reserves are used to produce top growth—the supply of reserves decreases.

Figure 1. Percentage of readily available carbohydrates in the roots of alfalfa at various stages of growth. (Wis. Agr. Exp. Sta. Res. Bul. 80, 1927).





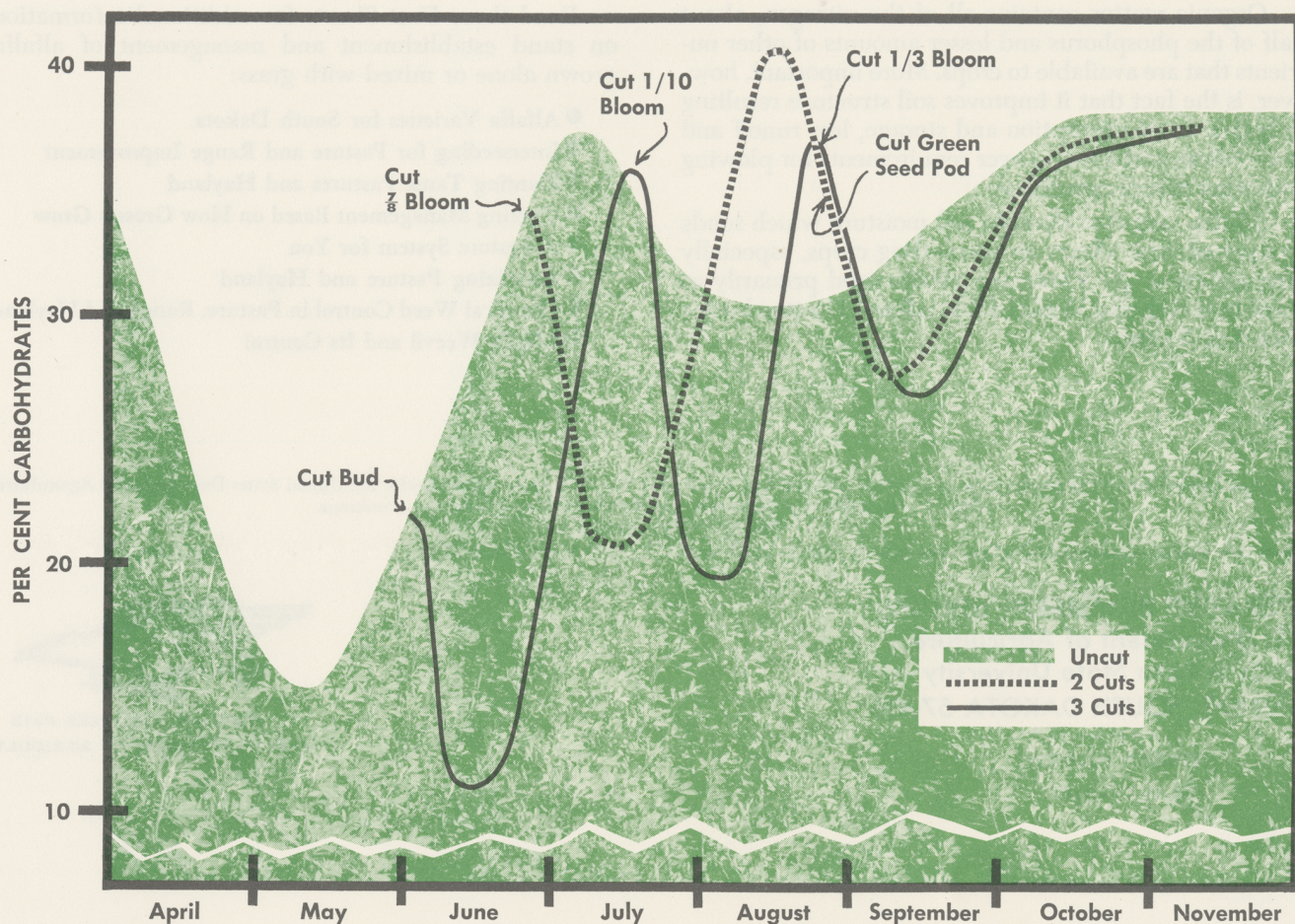


Figure 2. Seasonal trends of total available carbohydrates in roots of Vernal alfalfa with two cuttings, three cuttings and with no cutting (Univ. of Wis., Col. of Agr. and Life Sci., Res. Div. Bul. 542, 1968).

When plants are 6 to 8 inches tall there are enough leaves to manufacture food faster than it is needed for growth. The excess food moves to the roots and the supply of carbohydrates increases until the plant is in full bloom. The heavy demand on the carbohydrate supply for seed production results in a reduction of these reserves.

Figure 2 illustrates what happens to the root reserves when alfalfa is mowed for hay or grazed. It shows that the supply of carbohydrates in the roots decreases when new growth is being produced—either in early spring or shortly after being mowed. With uncut alfalfa the amount of reserves decreased until mid-May, increased until full-bloom in July, declined until seed was ripe in August and increased until tops were killed by frost in October.

With alfalfa that was cut twice, the amount of carbohydrates declined until mid-May and rose until cut at  $\frac{7}{8}$  bloom. It was lowered until new growth was 6 to 8 inches tall in July, and raised until cut a second time in August. Root reserves diminished until new growth was 6 to 8 inches tall and increased until tops were killed by frost in October.

The root reserves of alfalfa that is cut three times follow a similar cyclic pattern — they decrease after

each cutting until new growth is 6 to 8 inches tall then build back up.

Cutting for hay or grazing when root reserves are low results in very little energy being available to produce regrowth. The greatest damage occurs when alfalfa is cut while root reserves are at a minimum level (6 to 8 inches tall). Continued cutting or grazing at immature stages of growth will exhaust the root reserves, weaken and finally kill the plants. The nearer cutting is to full bloom, the higher the level of root reserves and the easier it is to maintain the plant's vigor and productivity. This is the reason why rotational grazing is recommended, especially for hay-type alfalfa.

Figure 1 indicates that the supply of root reserves is 50% greater in the fall of the year than it is when growth starts next spring. The difference is not quite so great in Figure 2. However, both indicate that plant food is used during fall and winter. They are used in autumn to develop cold resistance, to live on during winter and for many other processes within the plant. This maximum level varies from year to year depending on prevailing temperature and snow cover conditions in fall.

A high level of cold resistance is maintained when substantial snow cover provides protection during the coldest period of winter, but can vary as plants are ex-



posed to warmer temperatures. Resistance is not lost rapidly until after the snow is gone and the soil surface thaws in late March.

Plants at that time are quite susceptible to a rapid drop in temperature because they are beginning to lose cold resistance and are low in food reserves. Stubble helps to protect the plant over winter and particularly during late winter and early spring. Stubble left on the field in autumn will help collect more snow and hold it longer in spring than where there is no stubble.

#### Early Cutting for Better Quality

Cutting at early growth stages will provide hay of high quality with a high nutrient content. Constituents important to animal nutrition, such as total digestible nutrients (TDN), sugars, protein, carotene, amino acids, and minerals decrease in content as the plant advances in maturity. Animal feeding trials show conclusively that early cut alfalfa hay will produce more milk, wool and meat than late maturity hay.

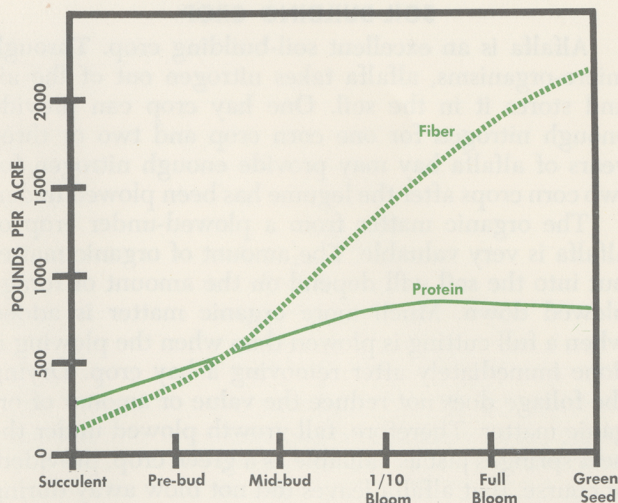
Figure 3 illustrates that protein yield increases until mid-bud stage of growth. Fiber yield rises slowly to this point and rapidly at later stages. Yield of protein and minerals may actually decrease after 1/10 bloom because of the loss of lower and older leaves which contain more of the nutrients than the stems. The upper internodes of the stems continue to elongate and the production of fiber continues to increase. Saving leaves is of prime importance in hay making and this can be done best by cutting before many of the lower leaves are lost. The use of varieties resistant to leaf disease is important to the production of quality hay.

Highest yield of the most important chemical constituents is obtained at near the 1/10 bloom stage of growth.

#### Managing Winter-Injured Stands

Losses due to winter conditions happen in two general ways. The alfalfa stands may be killed, or, more often, the stands are injured and weakened. Old stands

Figure 3. Yield per acre of protein and fiber for Vernal alfalfa at various stages of growth (Univ. of Wis., Col. Agr. and Life Sci., Res. Div. Bul. 542, 1968).



are more subject to winter losses than young or seedling stands.

Winter-injured stands are slow to start growth in spring. Plants may be weak in appearance, yellowish in color, and may have but a few growing stems. Farmers are often hasty in plowing such fields. Many or most of these stands will recover with delayed cutting or grazing. Delaying cutting to late June or to the full bloom stage will allow the plants time to heal the winter wounds and to store food in roots and crowns. The first cutting may be light and somewhat weedy but with a delayed first cutting, the second crop is often back to normal production. Early cutting of winter-injured stands may kill the weakened plants so that a light and weedy hay crop is produced in the second harvest as well as in the first.

Reseeding alfalfa, or even a grass, in stands that have been thinned by winterkilling is often unsuccessful. The old stand should be plowed or renovated to be reseeded, or even sown to another crop. An emergency crop, such as sudangrass, oats, millet, or soybeans, can be sown when feed is badly needed. Also, brome grass left from a mixture after winterkilling can be fertilized with nitrogen and used as emergency hay or pasture.

#### Autumn a Critical Period

September and October are always critical months for alfalfa. Alfalfa needs its leaf growth during this period to synthesize carbohydrates that are stored in the roots and crowns for use in overwintering. This can be done best by not cutting between the first of September and the first killing frost. Besides, hay yields during this period are usually low and the crop is hard to cure. Storage of food for winter in roots and crowns usually stops after a frost kills the top growth. There is little growth after frost and root reserves are not used for production of new growth. Therefore, removal of top growth after the first killing frost has little effect on the level of root reserves. Late autumn grazing is preferred to mowing, since moderate grazing will leave a stubble to catch and hold snow and protect the plants during winter. A minimum stubble height of 6 inches is recommended.

#### Cold Resistance

Alfalfa, like all northern-adapted perennials, develops cold resistance with onset of autumn's shorter days and cooler temperatures. Cold resistance is developed during the critical autumn months of September, October, and November. Consequently, cutting during this period can lower the hardiness developed, resulting in plants more susceptible to winterkilling.

Studies with Ranger and Vernal alfalfa show that the plants begin to develop cold resistance in early to mid-September and continue to build until a near maximum is reached in late November or early December shortly after permanent freezing of the soil.

#### GRAZING MANAGEMENT

Hay-type varieties recover quickly after being grazed. If grazed closely, root reserves are used to produce new top growth. Continuous close grazing will eventually deplete the root reserves and the alfalfa is



killed in 3 to 5 years. Hay-type varieties produce more forage than pasture-type varieties and may be more desirable for intensive grazing programs, such as with irrigation. Hay-type varieties should be grazed rotationally but not between September 1 and the first killing frost if high production is desired for longer than 3 to 5 years.

Pasture-type alfalfa produces a good first cutting but does not recover quickly after being mowed or grazed. As a consequence, it does not produce as much forage as a hay-type alfalfa and is less satisfactory as a hay crop. Since it does not produce as much top growth, it does not use as much root reserves, and does not kill out as easily as a hay-type alfalfa. Teton, for example, withstood 7 years of intensive grazing at Cottonwood, Highmore, and Brookings and 14 years at Eureka before grazing trials were terminated. Observations indicate that grazing intensity should be reduced after September 1.

The type of management of a pasture-type alfalfa-grass mixture should be determined by the characteristics of the grass. Pasture management of such mixtures is discussed more fully in Fact Sheet "A Pasture System for You."

#### **FERTILIZATION**

Alfalfa, as with other legumes, has the ability to take nitrogen from the air if the seed was inoculated with the proper bacteria before seeding. The bacteria multiply in root hairs and stimulate cells in the root to divide and form nodules on the upper roots near the central tap root. If nodules are pink or red in color, the bacteria are active and taking nitrogen from the soil air. They supply nitrogenous substances to the plant.

Therefore, nitrogen fertilizer is seldom needed for alfalfa production. Alfalfa, however, is a heavy user of phosphorus and potassium. Fertilizer application rates for these two elements on established legume stands should be based on soil test results. Apply the fertilizer by top-dressing either in the fall or as early as possible in the spring. If application is not possible in the spring because of wet ground, top-dress after removal of the first crop of hay.

More detailed information on the use of fertilizer can be obtained from Fact Sheet, "Fertilizing Pasture and Hayland."

#### **INSECT CONTROL**

Grasshoppers, pea aphids, spotted alfalfa aphids, alfalfa weevils and several species of leafhoppers all become troublesome in parts of South Dakota from time to time. Pea aphids and spotted alfalfa aphids are most common in eastern South Dakota. They generally infest the first cutting but sometimes are troublesome in the second cutting. During recent years, the population of spotted alfalfa aphids has built up to economic proportions and then subsided.

Leafhoppers generally infest the second cutting, but may attack the first cutting if mowed late or during years of an early spring. Alfalfa weevils are found only in or near the Black Hills. They generally attack the first cutting. Grasshoppers defoliate plants at any time during the season.

Aphids, leafhoppers, and weevils frequently become a problem shortly before the crop is ready to cut for hay. In such cases, they can be controlled by mowing a week earlier than usual. The ill-effects that early mowing may have on root reserves can be off set by mowing the next cutting later than usual. Losses from insects can be minimized by planting varieties that are tolerant to them. Dawson alfalfa, for example, has resistance to spotted alfalfa aphids, pea aphids, and potato leafhoppers.

Where resistant varieties are not used and the infestation does not come at a time when mowing will control the insects, several insecticides can be used. They are listed in the current edition of Extension Circular, "Insecticide Recommendations." Some are listed in Fact Sheets, "Grasshopper Control," and "Alfalfa Weevil and Its Control." The resistance of varieties adapted to South Dakota is discussed in Fact Sheet, "Alfalfa Varieties for South Dakota."

#### **WEED CONTROL**

Alfalfa in a full stand is usually a good weed competitor and has been used successfully to reduce stands of perennial noxious weeds as well as numerous annuals and biennials. Weed competition can be reduced during stand establishment by proper use of a companion crop, fallow, or herbicides. EPTC, benefin, and dalapon can be used to control annual grassy weeds, while 2,4-D, MCPA and 4(2,4-DB) can be used on annual broad-leaved weeds. Annual weeds sometimes invade poor stands of alfalfa and such herbicides as simazine, diuron, dalapon, or 4(2,4-DB) are helpful for controlling them.

More detailed information about weed control in alfalfa is given in Fact Sheets, "Chemical Weed Control in Pasture, Range and Hayland," "Planting Tame Pastures and Hayland," and "Chemical Weed Control in Crops."

#### **DISEASE CONTROL**

Although a number of diseases attack alfalfa, the only method of control is the use of tolerant varieties. Disease reaction of about a dozen varieties is given in Fact Sheet, "Alfalfa Varieties for South Dakota."

#### **SOIL-BUILDING CROP**

Alfalfa is an excellent soil-building crop. Through micro-organisms, alfalfa takes nitrogen out of the air and stores it in the soil. One hay crop can provide enough nitrogen for one corn crop and two or three years of alfalfa hay may provide enough nitrogen for two corn crops after the legume has been plowed under.

The organic matter from a plowed-under crop of alfalfa is very valuable. The amount of organic matter put into the soil will depend on the amount of forage plowed down. Much more organic matter is added when a full cutting is plowed than when the plowing is done immediately after removing a hay crop. Drying the foliage does not reduce the value or amount of organic matter. Therefore, fall growth plowed under the next spring is just as valuable as a green crop, provided, of course, that alfalfa leaves did not blow away during the winter.



Organic matter contains all of the nitrogen, about half of the phosphorus and lesser amounts of other nutrients that are available to crops. More important, however, is the fact that it improves soil structure resulting in better water absorption and storage, less runoff and soil erosion, and lower power requirements for plowing and other tillage operations.

Alfalfa uses considerable soil moisture which tends to have adverse affects on succeeding crops, especially long season crops. Therefore, alfalfa used primarily as a soil-building crop should not be allowed to stand more than 2 or 3 years.

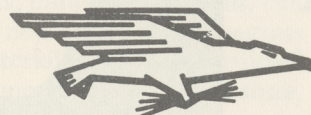
Read these Fact Sheets for additional information on stand establishment and management of alfalfa grown alone or mixed with grass:

- Alfalfa Varieties for South Dakota
- Interseeding for Pasture and Range Improvement
- Planting Tame Pastures and Hayland
- Grazing Management Based on How Grasses Grow
- A Pasture System for You
- Fertilizing Pasture and Hayland
- Chemical Weed Control in Pasture, Range and Hayland
- Alfalfa Weevil and Its Control

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture.  
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**Alfalfa**  
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